ER 77

ELECTRICAL WORKERS REGISTRATION BOARD

SAFETY | COMPETENCY | COMPLIANCE

Candidate Code No.	
For Board Use Only	
Result	Result
Date	Date
Int	Int

ELECTRICIANS REGULATIONS EXAMINATION

25 June 2016

QUESTION AND ANSWER BOOKLET

Time Allowed: Three hours

INSTRUCTIONS – READ CAREFULLY

You have 10 minutes to read this paper but do not start writing until you are told to do so by the supervisor.

Write your Candidate Code Number in the box provided above. Your name must NOT appear anywhere in this paper.

Answer all questions.

The pass mark for this examination is 60 marks.

Use a pen for written answers. **Do not** use pencils or red pens.

Drawing instruments and pencils may be used when diagrams are required. Marks are allocated on the basis of correctness.

Do not use correcting fluid or correcting tape.

It is recommended that the reference source for your answers be included in the space provided if a question can be answered from the Act, Regulations, Standard or Code of Practice. However, just stating a reference only will earn no marks.

For calculation questions all workings, including formulae, must be shown to gain full marks.

Warning – You could get 0 marks for any question, or part of a question, if you show anything hazardous or dangerous in your answer.

You will need to use the following documents in this examination:

- Electricity (Safety) Regulations 2010 reprint dated 1 August 2014 **or** the Electricity (Safety) Regulations reprint dated 4 April 2016.
- AS/NZS 3000:2007 (incorporating amendments 1 and 2)

PLEASE HAND THIS PAPER TO THE SUPERVISOR BEFORE LEAVING THE ROOM

(turn over)

Question 1

(a) Refer to the Electricity (Safety) Regulations 2010 and state **TWO** situations where **low voltage fittings** are deemed to be electrically unsafe **before** they are installed in an electrical installation.

(2 marks)

(1) ____

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(2) ____

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Ref: ....

(b) (i) Refer to the Electricity (Safety) Regulations 2010 and state the maximum operating time permitted for a RCD installed for the protection of property.

(1 mark)

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Ref: ....

(ii) Refer to the Electricity (Safety) Regulations 2010 and state the maximum rated residual current permitted for a RCD installed for the protection of property.

(1 mark)

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Ref: ....

(turn over)

Question 1 continued

(c) Alterations and additions have been carried out in **part** of an existing low voltage electrical installation in accordance with Part 2 of AS/NZS 3000.

Refer to AS/NZS 3000 and state what must be verified in respect to the other part of the existing electrical installation where no alteration and additions were carried out.

(2 marks)

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Ref: ....

(d) Refer to AS/NZS 3000 and state **TWO** situations where the maximum demand of an electrical installation can be determined by assessment.

(2 marks)

(1) ____

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(2) ____

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Ref: ....

(turn over)

Question 1 continued

(e) A 4mm^2 two core neutral-screen submain cable is to be buried direct (unenclosed) between two buildings.

(i) Refer to AS/NZS 3000 and state **ONE** requirement for indicating the position of the buried cable **while it is being installed**.

(1 mark)

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Ref: ....

(ii) Refer to AS/NZS 3000 and state **ONE** requirement for indicating the position of the buried cable **after it has been installed**.

(1 mark)

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Ref: ....

(f) Refer to AS/NZS 3000 and state **TWO** requirements for **capacitors connected in parallel with individual appliances**.

(2 marks)

(1) ____

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(2) ____

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Ref: ....

(turn over)

Question 1 continued

(g) Refer to AS/NZS 3000 and state **TWO** requirements for the **connection to an earth electrode** of a main earthing conductor.

(2 marks)

(1) ____

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(2) ____

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Ref: ....

(h) Refer to AS/NZS 3000 and state the **TWO** situations **in a bathroom in a domestic electrical installation** where RCD protection is required for a socket outlet.

(2 marks)

(1) ____

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(2) ____

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Ref: ....

(turn over)

Question 1 continued

(i) Refer to AS/NZS 3000 and state **TWO** requirements for **overcurrent protection** for an extra-low voltage circuit where the supply is earthed at the point of supply.

(2 marks)

(1) ____

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(2) ____

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Ref: ....

(j) Refer to AS/NZS 3000 and define **ONE** **hazardous area**.

(2 marks)

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Ref: ....

(turn over)

Question 2

AS/NZS 3000 details safety outcomes for electrical installations to ensure they are electrically safe in accordance with the Electricity (Safety) Regulations 2010.

Automatic disconnection of supply is one method of fault protection (protection against indirect contact).

(a) Refer to AS/NZS 3000 and state **TWO** methods of achieving automatic disconnection of supply.

(2 marks)

(1) ____

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(2) ____

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Ref: ……………………………………

(turn over)

Question 2 continued

(b) **Earthing system impedance** is a fundamental aspect of the automatic disconnection of supply method of protection.

Refer to AS/NZS 3000 and state the characteristics required of the protective devices and the earthing system impedance where the automatic disconnection of supply method of protection is used.

(2 marks)

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Ref: ………………………………………

(turn over)

Question 2 continued

(c) An earth fault loop impedance test is being carried out on a single phase socket outlet in a 230V electrical installation.

Refer to AS/NZS 3000 and describe the circuit the earth fault loop impedance tester is testing.

(6 marks)

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Ref: ....

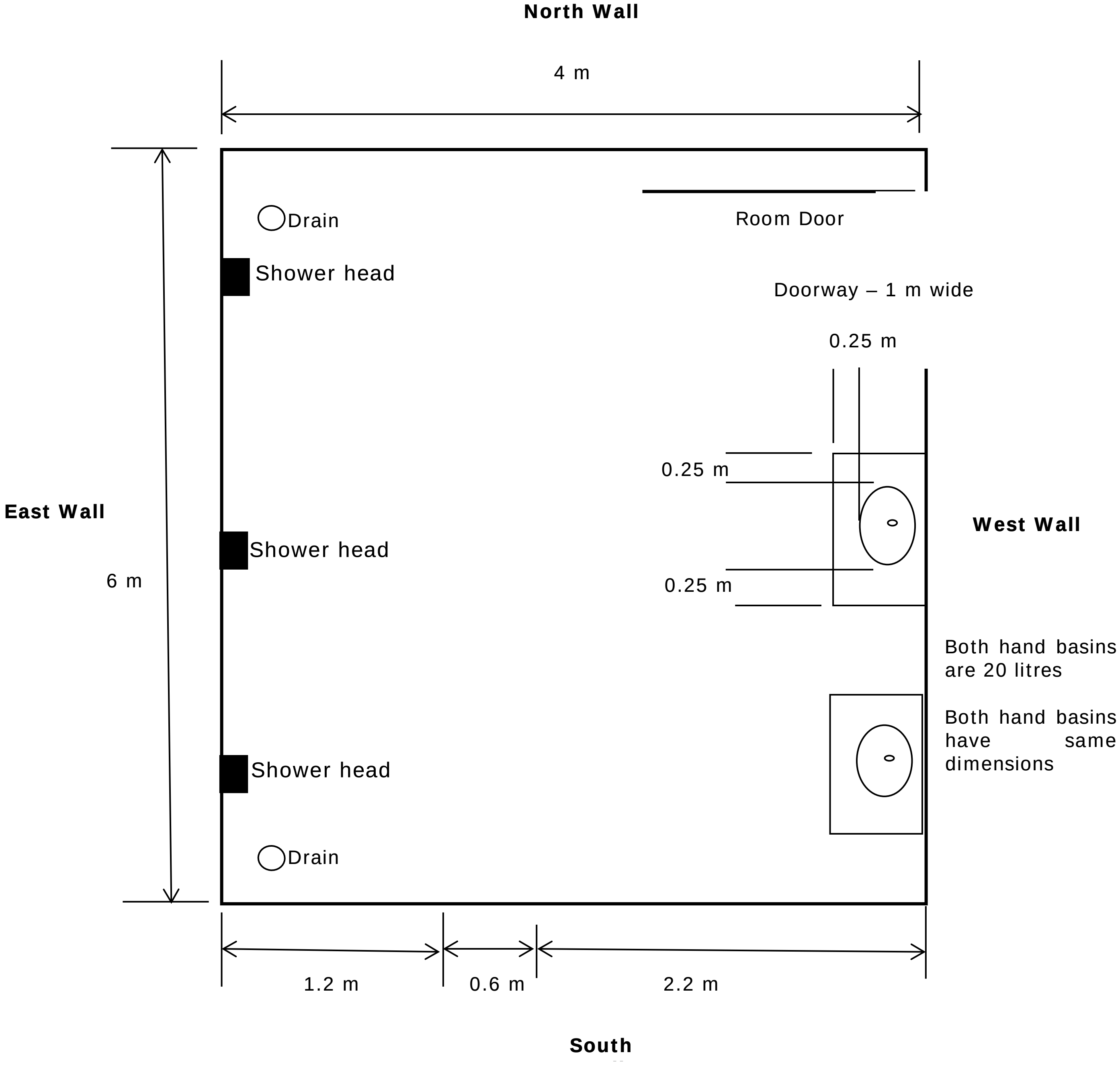
(turn over)

Question 3

Introduction

This figure is a communal bathroom installed in a sports area. The shower completely covers one half of the room.

The room ceiling height is 2.2 m.



Use the information in the introduction to this question to answer parts 3(a), 3(b), 3(c), 3(d), 3(e) and 3(f).

(turn over)

Question 3 continued

(a) (i) Refer to AS/NZS 3000 and on the figure in the introduction, draw the Zones of the shower.

(2 marks)

Ref: ....

(ii) Refer to AS/NZS 3000 and on the figure in the introduction, draw the Zones for the two hand basins.

(1 mark)

Ref: ....

(b) Three luminaires are to be installed on the ceiling above the shower, 1 metre from the east wall.

(i) Refer to AS/NZS 3000 and state the Zone of the shower in which the luminaires will be installed.

(½ mark)

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Ref: ....

(ii) Refer to AS/NZS 3000 and state the degree of protection required for the luminaires.

(½ mark)

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Ref: ....

(c) Three luminaires are to be installed on the ceiling above the hand basins, 1 metre from the west wall.

(i) Refer to AS/NZS 3000 and state the Zone of the shower in which the luminaires will be installed.

(½ mark)

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Ref: ....

(ii) Refer to AS/NZS 3000 and state the degree of protection required for the luminaires.

(½ mark)

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Ref: ....

(turn over)

Question 3 continued

(d) A double light switch is to be installed on the west wall of the bathroom and must be accessible to those entering the bathroom.

(i) On the figure in the introduction draw the position the double light switch.

(½ mark)

____

Ref: ....

(ii) Refer to AS/NZS 3000 and state the degree of protection required for the light switch.

(½ mark)

____

Ref: ....

(e) An automatic hand-dryer and associated permanent connection unit is to installed between the two hand basins.

(i) Refer to AS/NZS 3000 and state which Zone of the shower the hand dryer and permanent connection unit will be installed.

(½ mark)

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Ref: ....

(ii) Refer to AS/NZS 3000 and state the degree of protection required for the automatic hand-dryer and associated permanent connection unit.

(½ mark)

____

Ref: ....

(turn over)

Question 3 continued

(f) A **230V** socket outlet is to installed on the west wall of bathroom but not under a hand basin.

(i) Refer to AS/NZS 3000 and state which Zone of the shower the socket outlet will be installed.

(½ mark)

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Ref: ....

(ii) Refer to AS/NZS 3000 and state the degree of protection required for the socket outlet.

(½ mark)

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Ref: ....

(iii) Refer to AS/NZS 3000 and state the **TWO** methods of electrical protection that can be used for the socket outlet.

(2 marks)

(1) ____

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(2) ____

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Ref: ....

(turn over)

Question 4

New 230V TPS subcircuits have been installed in a factory.

(a) (i) Refer to AS/NZS 3000 and state why the testing of the **continuity of the earthing system** of the factory is necessary.

(2 marks)

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Ref: ....

(ii) Refer to AS/NZS 3000 and state the **TWO** results required when a protective earthing conductor of a new TPS circuit has been tested.

(2 marks)

(1) ____

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(2) ____

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Ref: ....

(turn over)

Question 4 continued

(b) Three 2.5 mm^2 twin and earth TPS final subcircuits supply socket outlets and are protected by 20A, Type C MCBs. The disconnection time for the MCBs must comply with clause 1.5.5.3(d)(i) of AS/NZS 3000.

(i) Refer to AS/NZS 3000 and state the maximum permitted earth fault loop impedance for each of the final subcircuits.

(½ mark)

____

Ref: ………………………………….

(ii) Refer to AS/NZS 3000 and state the maximum permitted resistance for the protective earthing conductors of each of the final subcircuits.

(½ mark)

____

Ref: ………………………………….

(iii) Refer to AS/NZS 3000 and state the maximum permitted resistance for the active conductors of each of the final subcircuits.

(½ mark)

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Ref: ………………………………….

(iv) Refer to AS/NZS 3000 and state the maximum permitted length for each of the final subcircuits.

(½ mark)

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Ref: ………………………………….

(turn over)

Question 4 continued

(c) A 6 mm^2 twin and earth TPS final subcircuit supplies a permanently-connected sausage making machine and is protected by a 40A gG HRC fuse.

The disconnection time for the HRC fuse must comply with clause 1.5.5.3(d)(ii) of AS/NZS 3000.

(i) Refer to AS/NZS 3000 and state the maximum permitted earth fault loop impedance for this final subcircuit.

(½ mark)

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Ref: ………………………………….

(ii) Refer to AS/NZS 3000 and state the maximum permitted resistance for the protective earthing conductor for this final subcircuit.

(½ mark)

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Ref: ………………………………….

(iii) Refer to AS/NZS 3000 and state the maximum permitted resistance for the active conductor for this final subcircuit.

(½ mark)

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Ref: ………………………………….

(iv) Refer to AS/NZS 3000 and state the maximum permitted length for this final subcircuit.

(½ mark)

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Ref: ………………………………….

(turn over)

Question 4 continued

(d) Refer to AS/NZS 3000 and state **TWO** results required when correct circuit connection tests have been carried out on the 230V final subcircuits.

(2 marks)

(1) ____

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(2) ____

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Ref: ....

(turn over)

Question 5

Introduction

A modular main switchboard is being installed in a new domestic residence.

The switchboard comprises the following:

Number	**Fitting**
1	Single-pole 63A main switch
1	Earth bar
1	Main neutral bar
1	32A MCB
1	20A MCB
1	16A MCB
2	10A RCBOs
5	20A RCBOs

The cables requiring connection to the switchboard are:

Number	**Cable**
1	16 mm^2 twin consumers mains cable
1	6 mm^2 main earthing conductor
1	6 mm^2 twin and earth TPS cable supplying an oven
1	1.5 mm^2 twin and earth TPS cable supplying a permanently-connected storage water heater
1	2.5 mm^2 twin and earth TPS cable supplying a garage
1	2.5 mm^2 twin and earth TPS cable supplying a permanently-connected hair-dryer in a bathroom
5	1.5 mm^2 twin and earth TPS cables supplying lights
14	2.5 mm^2 twin and earth TPS cables supplying socket outlets

Only those final subcircuits that are required to be protected by an RCBO in accordance with AS/NZS 3000 are to be connected to a RCBO.

Use the information in the introduction to this question to answer parts 5(a) and 5(b).

(turn over)

Question 5 continued

(a) (i) What is required to be connected between the main neutral bar and the earth bar?

(½ mark)

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(ii) To where are the conductors of the 16 mm^2 twin mains cable connected?

(1 mark)

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(iii) To where is the 6 mm^2 main earthing conductor cable connected?

(½ mark)

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(b) Only those final subcircuits that are required to be protected by an RCBO in accordance with AS/NZS 3000 are to be connected to a RCBO.

(i) Which final subcircuit cables in the introduction are required to be protected by an RCBO?

(2 marks)

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(turn over)

Question 5 continued

(ii) Refer to AS/NZS 3000 and state how the final subcircuits stated in (b)(i) are distributed across the RCBOs.

(5 marks)

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(iii) How is the active supply to the RCBOs arranged?

(½ mark)

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(iv) How is the neutral supply to the RCBOs arranged?

(½ mark)

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(turn over)

Question 6

A single-phase 230V, submain is to be run between a main switchboard and a new science classroom in a **SCHOOL**.

The maximum demand of the classroom has to be determined so the correct size submain cable can be obtained.

Refer to AS/NZS 3000 and determine the maximum demand in amps of the classroom that has the following loads:

Number	**Equipment**
17	45W fluorescent lights
4	60W outside lights
10	10A single socket outlets
2	15A single socket outlets
2	1.5 kW automatic hand-dryers
2	2 kW instantaneous water heaters
1	6 kW input air conditioner

Use the table on the following page for your calculations.

(10 marks)

(turn over)

Question 6 continued

Equipment	Load Group	Calculation	Load A
17 45W fluorescent lights			
4 60W outside lights			
10 10A single socket outlets			
2 15A single socket outlets			
2 1.5 kW automatic hand-dryers			
2 2kW instantaneous water heaters			
1 6 kW input air conditioner			
Total			

Ref: ....

(turn over)

Question 7

Every electrical installation has (at least) one switchboard.

(a) A main switchboard is installed in the **corner** of a switchroom. The switchroom has one access door located in a passage.

(i) Refer to AS/NZS 3000 and state the **TWO** requirements for the **space in front of the switchboard**.

(2 marks)

(1) ____

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(2) ____

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Ref: ....

(ii) Refer to AS/NZS 3000 and state the **TWO** requirements for the access door located in the passage.

(2 marks)

(1) ____

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(2) ____

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Ref: ....

(turn over)

Question 7 continued

(b) **A neutral bar or link** must be installed in an MEN switchboard.

Refer to AS/NZS 3000 and state **TWO** requirements for the connection of the incoming (main) neutral conductor.

(2 marks)

(1) ____

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(2) ____

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Ref: ……………………………………..

(c) Every main switch on a switchboard must comply with the requirements for an isolation device.

Refer to AS/NZS 3000 and state **FOUR** requirements for an **isolation device**.

(2 marks)

(1) ____

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(2) ____

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(3) ____

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(4) ____

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Ref: ……………………………………..

(turn over)

Question 7 continued

(d) An MEN switchboard supplies two distribution boards.

State **ONE** reason why the two distribution boards **do not** have MEN links.
(2 marks)

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(turn over)

Question 8

(a) **Introduction**

Ten new bedrooms are being wired in an extension to an existing hotel complex. All final subcircuits operate at 230V and comprise:

- Two 1.5 mm^2 lighting final subcircuits in each new bedroom.
- Three 2.5 mm^2 socket outlet final subcircuits in each new bedroom.
- Two 1.5 mm^2 lighting final subcircuits in the common hall way to the new rooms.
- Three 2.5 mm^2 socket outlet final subcircuits in the common hall way to the new rooms.

The common hallway **is not** a residential electrical installation.

Use the information in the introduction to this question to answer parts (a)(i), (a)(ii), (a)(iii), (a)(iv) and (a)(v).

(i) Refer to AS/NZS 3000 state which final subcircuits are **required** to have RCD protection.

(2 marks)

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Ref: ....

(ii) The two lighting final subcircuits in each new bedroom are protected by a combination of RCCBs and MCBs.

Refer to AS/NZS 3000 and state how many RCCBs and MCBs are required for the two lighting final subcircuits.

(1 mark)

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Ref: ....

(turn over)

Question 8 continued

(iii) The three socket outlet final subcircuits in each new bedroom are protected by a combination of RCCBs and MCBs.

Refer to AS/NZS 3000 and state how many RCCBs and MCBs are required for the three socket outlet final subcircuits.

(1 mark)

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Ref: ………………………………….

(iv) The two lighting final subcircuits in the common hall way are protected by RCBOs.

Refer to AS/NZS 3000 and state how many RCBOs are required for the two lighting final subcircuits.

(½ mark)

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Ref: ………………………………….

(v) The three socket outlet final subcircuits in the common hall way are protected by RCBOs.

Refer to AS/NZS 3000 and state how many RCBOs are required for the three socket outlet final subcircuits.

(½ mark)

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Ref: ………………………………….

(turn over)

Question 8 continued

(b) **Introduction**

Four existing rooms in a hotel complex are being converted to self-contained units.

The new work comprises:

- A new switchboard in each unit.
- A new 6 mm^2 final subcircuit for a socket outlet for a free-standing range.
- A new 2.5 mm^2 final subcircuit for a permanently connected instantaneous water heater.
- Three new 2.5 mm^2 socket outlet final subcircuits in each unit.

The existing wiring is MCB protected but not RCD protected and includes:

- Two existing 1.5 mm^2 lighting final subcircuits in each unit.
- Three existing 2.5 mm^2 socket outlet final subcircuits in each unit.

Use the information in the introduction to this question to answer parts (b)(i) and (b)(ii).

(i) Refer to AS/NZS 3000 and state which final subcircuits **are required** to be protected by RCD.

(1½ marks)

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Ref: ....

(turn over)

Question 8 continued

(ii) Refer to AS/NZS 3000 and state the reasons why some final subcircuits stated in the introduction **are not** required to be protected by RCD.

(3½ marks)

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Ref: ……………………………………..

(turn over)

Question 9

(a) Refer to AS/NZS 3000 and state where the **THREE** points in the MEN system where the neutral conductor is earthed.

(3 marks)

(1) ____

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(2) ____

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(3) ____

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Ref: …………………………………..

(b) Refer to AS/NZS 3000 and state the requirement where earthing is used for combined protective and functional purposes.

(1 mark)

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Ref: …………………………………..

(turn over)

Question 9 continued

(c) Refer to AS/NZS 3000 and state **ONE** requirement where **conductive conduit** may be regarded as a protective earthing conductor.

(2 marks)

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Ref: ………………………………….

(d) Refer to AS/NZS 3000 and state **ONE** requirement relating to the **continuity** of earthing conductors is relation to **connecting devices**.

(2 marks)

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Ref: ………………………………….

(turn over)

Question 9 continued

(e) **Constructional requirements** mean that protective earthing conductors are connected to electrical equipment by means of a **bolt, stud or screw** that is an integral part of the electrical equipment.

Refer to AS/NZS 3000 and state **TWO** restrictions on the use of the integral **bolt, stud or screw**.

(2 marks)

(1) ____

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(2) ____

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Ref: ………………………………………..

For Candidate's Use

In the box, write the number of **EXTRA** sheets you have used. Write **NIL** if you have not used any

For Examiner's Use Only		
Questions Answered	**Marks**	
1		
2		
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9		
TOTAL		